ILLINOIS SOCIETY OF PROFESSIONAL ENGINEERS
FOUNDED 1886

the ILLINOIS ENGINEER

NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS
FOUNDED 1934

"Our Surface Water Resources" in This Issue

RALPH R. BARTELSMEYER, MEMBER I.S.P.E.
CHIEF HIGHWAY ENGINEER, ILLINOIS DIVISION OF HIGHWAYS

(See page 1)

THE ILLINOIS ENGINEER, APRIL, 1954—VOLUME XXX, NO. 4

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Of Professional Interest

THE ILLINOIS ENGINEER—THIS MONTH

RALPH R. BARTELSMEYER

Chief Highway Engineer

On December 3 last, Governor Stratton appointed Ralph R. Bartelsmeyer of Belleville, Illinois to the post of Chief Engineer for the Illinois Division of Highways, effective on December 15.

Mr. Bartelsmeyer's appointment was no surprise, for not only was his name among several engineers recommended as fully qualified for the post by representatives of the leading engineering organizations of the State, but also because he has been a career highway engineer for over 20 years in Illinois.

He is well known among the engineers of the Division of Highways especially in the southern half of the State, for his 12 years in Washington County and five years in St. Clair County as Superintendent of Highways, kept him in close contact with State Highway personnel. Moreover, Mr. Bartelsmeyer began his highway engineering experience as an employee of the Division of Highways in 1930 in the East St. Louis District while a student at the University of Illinois. After his graduation from the University as a civil engineer, he was employed full time until 1934 by the Division of Highways in the Peoria District.

He has served as president of the Illinois Association of County Superintendents and the Illinois Engineering Council, and is a member of the Illinois Society of Professional Engineers, and the American Road Builders Association, two organizations which have many members from the ranks of the Illinois Division of Highways.

Mr. Bartelsmeyer is a registered professional engineer in Illinois and Missouri and a registered Illinois land surveyor. He is married and has two sons, is an Elk, a Mason, and a member of Signal Hill Methodist Church, East St. Louis.

The Illinois Society of Professional Engineers extends its best wishes to Mr. Bartelsmeyer as Chief Highway Engineer for the State of Illinois.

COST OF LIVING INDEX

The cost of living correction factor to be applied to the I.S.P.E. Schedule of Minimum Fees and Salaries was 192.6 for January, 1954. This factor is based upon a 1935-39 average taken as 100.

At the present time the Bureau of Labor Statistics is basing its Consumer Price Index upon a 1947-49 average. The figure of 192.6 given above has been converted from this average. This would seem to be the logical method of presentation until the Society publishes a new Fees and Salaries Schedule established upon the 1947-49 base.

A man's ability is usually rated by what he finishes and not by what he starts.

PRESIDENT'S REPORT—69th ANNUAL MEETING

RAYMOND BRICHLER, Retiring President

During my term as President, I visited thirteen of our sixteen Chapters, attended all Board of Direction and Executive Committee meetings, several committee meetings of the State Society, Chapter Officers' Conference at Peoria, Conference of Presidents of various State Societies of NSPE at Louisville, Kentucky, the Convention of NSPE at Daytona Beach, Florida, a regional meeting of Central Area of NSPE at Indianapolis, Indiana, which was held concurrently with the Annual Meeting of Indiana Society and NSPE Board of Direction meeting. I also participated in the charter nights of the Ladies' Auxiliaries of Champaign County Chapter and St. Clair Chapter. All of this has involved a travel of about 10,300 miles, with necessary expenditures totaling some $800.00, which was contributed by your President.

We have just completed an extensive membership campaign (or, let's say, we completed a phase of our membership campaign, as membership campaigns in reality are never completed). They must continue! While the results of the campaign were not as high as I had hoped for, still it gave us a great deal of publicity. It opened a field into which further exploitation should continue. Each of our Chapters has that list of prospects to whom the issues of THE ILLINOIS ENGINEER were forwarded, together with that personal touch of bearing the name of the member who has mailed the issues. I ask you to see to it that your Chapters continue to use this list and the list of Registered Professional Engineers that are forwarded to your Chapter by the State headquarters. I feel that our field for membership is tremendous, but we must continue to make personal contact with prospective members. As an overall Profession, it is desirous that the now-existing State members take up full membership in NSPE. There should be a special effort made to inform all members of ISPE of many Professional matters of National significance being handled by the National Society.

CONTENTS OF THIS ISSUE

READ THE ADVERTISEMENTS

SUBSCRIPTION RATES

$2.00 per year in advance to members of the Illinois Society of Professional Engineers. $4.00 per year in advance to non-members in U.S.A. and possessions, Canada, and Mexico. Foreign $6.00. Single copies 40c.

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The matter of allowing membership-drops, due to non-payment of dues, is a matter that I find to be immediately in need of express action in overcoming. I believe a matter of personal contact with the delinquent is needed down through the Chapters. Most drops, you will find, are due to carelessness through oversight of dues-payment. We should be able to recover no less than 75% of the drops, if some system is set up throughout the various Chapters. If we were merely to recover the drops, our membership would number at least 2,500 today.

I, therefore, suggest that a State-wide Lapsation Committee be formed, such as is done by some of our fraternal organizations. The State Committee should consist of a member from each Chapter (Chapter Secretary, if preferred) with sub-committees appointed by each Chapter. The purpose of the Committee would be to prevent membership drops. It is further suggested that the duties of the committee be set up by the State President.

During the past month, we were able to develop another "Historic First" for ISPE in the formation of the Student Chapter at Bradley University of Peoria. This was a noteworthy accomplishment. Those people who have taken part in the forming of the Chapter are to be commended. We need to do more for our Young Engineers, that is—the students and engineers-in-training. They represent the future of the Society. I hope the time will come when we can assist deserving students in their quest for higher engineering education by establishing scholarship funds at both Chapter and State levels. We should assist students in finding part-time employment, where necessary. A "courtesy card" could be issued to graduating engineers of the engineering schools over the State. This would entitle the graduate to privileges in the local Chapter nearest their residence. We should furnish speakers for high schools, outlining the possibilities of an engineer-career. Chapters should conduct active programs to obtain and hold the interest of their EIT members. I suggest that your local Chapters and individuals refer to your State Committees and State Officers for assistance in aid and counsel on this item.

Notable progress has been made in providing Refresher Courses throughout the State. I wonder, however, if we are following through in trying to get those people who are taking these courses to join with us. Here is a great potential!

Continued and accelerated work should be done in behalf of the engineers in the employ of the State Highway Department and in other and many diversified fields of the various Departments of Public Works, in the County, City and other municipal subdivisions. While it is true that we have a committee of State Engineering Employees, this committee should be expanded to include some members who are not state employees.

During the year, we were able to print a membership roster. It is now time that we consider printing of the revised Constitution, Fees and Salaries, and Code of Ethics. I hope that the coming administration will be able to proceed with this work.

In closing, I express my appreciation to the Committee Chairmen and their committees for their splendid reports. I thank the members of the Board of Direction, the Secretary, the Executive Secretary, the Editor-in-Chief and Associate Editor of THE ILLINOIS ENGINEER, the Chapter Officers, and each individual member for his cooperation during my term of office. If my year in office was in any measure a success, I owe it all to the fine support given by you. The hospitality shown me when I visited your Chapters was heart-warming. I will forever be proud of the trust you placed in me.

I am happy to turn over the leadership of ISPE to such a worthy successor as Clarence W. Klassen and our new Vice-President Dwain M. Wallace. Please give them your wholehearted support.

REGISTRATION AT THE 69TH ANNUAL MEETING

East St. Louis, March 25-26-27, 1954

A very successful Annual Meeting was held in E. St. Louis on the last weekend of March. Following is a breakdown by chapters of the numbers attending. There was a total registration of 370 men and women, the largest in recent years.

	Men	*Women*
Ambraw	3	3
Capital	24	10
Central Illinois	16	4
Champaign	11	4
Chicago	15	6
DuKane	6	1
Egyptian	1	0
Illinois Valley	3	1
Joliet	2	1
Lake County	7	1
Madison	28	11
Peoriarea	6	2
Rockford	4	1
Rock River	4	2
St. Clair	78	56
West Central	6	1
Bradley Student	2	0
Missouri S. P. E.	10	8
N. S. P. E.	1	1
Scott Field	2	0
Guests	28	—
	257	113

I hold every man a debtor to his profession; from the which as men of course do seek to receive countenance and profit, so ought they of duty to endeavor themselves by way of amends to be a help and ornament thereunto.

Sir Francis Bacon

Engineers' Week Activities—A Review

The most unusual example of Engineers' Week activity was an eight-page Professional Engineers' Section published as a part of the *Waukegan News-Sun* on February 22. Mr. Frank J. Furlan, Jr., Publicity Chairman, Lake County Chapter, stated that the Chapter felt that the best way to reach the public in this area was to have a special edition published. Mr. M. E. Amstutz was the chairman of the committee that made the arrangements, also handled all the details in connection with the edition. The majority of the articles in the Section was written by members of Lake County Chapter, with a few condensed stories from the larger industries. The advertisement subscribers were contacted by Chapter members and the *News-Sun* actually solicited the ads from the subscribers. To get out an edition like this called for at least $1,800.00 worth of advertisements. However, the *News-Sun* said that the ads totaled up to $2,200. In addition, Mayor Robert E. Coulson signed a proclamation officially designating the week of February 21-27, as Engineers' Week, in the City of Waukegan.

DuKane Chapter specialized in window displays. One in Elgin was prepared by George Booth and one in Aurora was prepared by Richard Thornton. Mayor Myron Leham of Elgin and Mayor Paul Egan of Aurora both issued proclamations. The signing of the proclamation in Aurora is shown in the accompanying picture. Mr. Rob Roy, DuKane's active Publicity Chairman, is seen assisting in the event.

In Champaign County Chapter, Mr. W. J. Roberts, Publicity Chairman, sponsored the showing of the film, "A Pilgrimage to Mount Vernon", at the local TV station.

The following notes extracted from *Capital Chapter Chatter* indicate that Engineers' Week was fully recognized in their vicinity:

The week of February 22nd brought about one of the best local public relation efforts the Chapter has had. Under the leadership of committee chairman Earl Rynearson, events rang the register of recognition. . . . Prexy Golly spoke before the Cosmopolitan Club. . . . Also featured was the 15-minute radio program played on Springfield Station WCVS. . . . A 6-minute television presentation over Springfield Station WICS. (Thanks, Clyde). . . . Mayor MacWherter proclaimed Engineer's Week in Springfield. . . . Springfield newspapers gave 72 inches of space or six column feet of news on engineer activities. . . . Rotary Club, under the guid-

Mayor Paul Egan of Aurora Signs Engineers' Week Proclamation

Standing, left to right—G. H. Deuchler, City Engineer; Glen Paimeier, Mayor's Secretary; Rob Roy, Past President DuKane Chapter. Seated, pen in hand—Honorable Paul Egan, Mayor of Aurora, and John Thill, Commissioner of Finance.

ance of "Al" Senter and "Walt" Marquardt, held an engineers' recognition night. . . . At Rotary, "Kit" Thomas, NSPE vice-president, spoke before a full house.

Chicago also celebrated the event. February 19, 1954—Mayor Kennelly signed Engineers' Week Proclamation in presence of local officers. February 21, 1954—Newspapers carried story of signing. February 22, 1954— V. E. Gunlock, Commissioner of Public Works, was interviewed on WMAQ (radio) concerning Engineers' Week. February 22, 1954—George L. DeMent, Administrative Engineer of the Department of Public Works, spoke before the Chicago General Passenger Agents Club on "Engineers' Week and City Traffic." February 24, 1954—V. E. Gunlock, Commissioner, George L. DeMent, Administrative Engineer, and John G. Duba, Assistant Administrative Engineer, all of Chicago's Department of Public Works, appeared on WGN-T.V. for a 30-minute program concerning Engineers' Week and Public Works. This same group presented two more programs on March 3rd and 10th. February 24, 1954—John G. Duba, Assistant Administrative Engineer in Chicago's Department of Public Works, presented a talk at the Lyons Township High School on "Engineering as a Career." February 26, 1954—George L. DeMent addressed a group of engineers and planners of the Chicago Plan Commission.

It is known that other chapters also carried out Engineers' Week programs. The examples described above are typical of what went on throughout the state and show that the Engineers' Week idea is growing year by year at an accelerated rate.

OIL HYDRAULICS REFRESHER COURSE AT I.I.T.

A two-week refresher course in "Basic Oil Hydraulics" will be offered for the first time this summer by Illinois Institute of Technology in Chicago.

Initiated at the request of numerous industries using oil hydraulics, the course is designed for maintenance technicians and others already working in the hydraulics field.

The refresher course, which will be non-credit, will be held from June 7 through June 18, 1954, on the I.I.T. campus.

Illinois Tech offers the most complete educational program in the United States in the rapidly growing field of oil hydraulics. The school also sponsors the annual National Conference on Industrial Hydraulics.

Further information about the new summer course may be obtained from the Department of Mechanics, Illinois Institute of Technology, 3300 S. Federal street, Chicago 16, Ill.

An educational and research laboratory in oil hydraulics—the most complete such facility in the United States—has been established at Illinois Institute of Technology in Chicago.

The new I.I.T. laboratory offers a broad educational program ranging from intense short courses (the first of these is described above) to graduate-level research.

REPORT FROM CHAMPAIGN COUNTY AUXILIARY

(Prepared by MRS. G. E. EKBLAW)

A delightful Valentine party was held Saturday, February 13, in the spacious home of Mrs. Harold E. Babbitt, 705 W. Main St., Urbana. Forty members and guests of the auxiliary to the Champaign County chapter of the Illinois Society of Professional Engineers played bridge and canasta following dessert.

After a short business meeting, conducted by Mrs. John T. Kearns, vice-president, presiding in the absence of president, Mrs. M. H. Kinch, plans were discussed to attend the State convention to be held in East St. Louis on March 25 to 27th. An invitation from President Brichler's wife was read by Mrs. George Ekblaw, secretary.

Special events will include a trip to a TV audience participation show, and other instructive and interesting trips are being offered. The possibility of a chartered bus was discussed.

Two new members were introduced, Mrs. Robert A. Jewett of Champaign and Mrs. Troy O. Timm of Tuscola.

Mrs. Babbitt was hostess with Mrs. Herbert L. White as general chairman. Mrs White's committee included Mrs. Charles A. Clinard, Mrs. W. A. Oliver, Mrs. J. W. Briscoe, and Mrs. Robert Harmeson.

Mrs. James L. Leach won the special prize and high scorer at each table won the potted plant which decorated the individual tables.

The next meeting of the auxiliary will be a joint meeting with the men, featuring dinner and program at Allerton on May 6.

ROCK RIVER CHAPTER ISSUES RESOLUTION ON THE DEATH OF H. C. REEDER

RESOLUTION

In recognition of the sincere interest of Herbert C. Reeder in the Rock River Chapter, Illinois Society of Professional Engineers, the Rock River Chapter, Illinois Society of Professional Engineers at its meeting at Dixon, Illinois on February 25, 1954, wishes to express its sense of personal loss in the death of Mr. Reeder, and its appreciation of his services as a member of the Society.

Mr. Reeder was a Charter member of the Chapter and was always willing to contribute his efforts and ideas for the advancement and betterment of the engineering profession.

BE IT THEREFORE RESOLVED, That this expression of appreciation be sent to the family of Mr. Reeder and that a copy be forwarded to the State Office of the Society.

ROBERT HOFMANN, President
Rock River Chapter

One man's word is no man's word; we should quietly hear both sides.

—Goethe

Report of the National Director

N. S. P. E. Board Meeting — Albuquerque, New Mexico, February 18-20, 1954

George L. DeMent

The Board of Directors of the National Society of Professional Engineers held their Spring Meeting in Albuquerque, New Mexico, February 18-20, 1954, in the Hilton Hotel as guests of the New Mexico Society of Professional Engineers.

It was significant that all states were represented at the first roll call.

President T. Carr Forrest, Jr. presided at the general business sessions of the Board during which the reports of the various committees were made.

The reports of the committees included the following: Budget, Constitution and Bylaws, Education, Employment Practices, Ethical Practices, Legislative, Membership, National Defense, Publications, Public Relations, Registration, Resolutions, Young Engineers, Awards, Building Advisors, Chapter Activities, Compendium of Registration Laws, Engineer-in-Industry, Interprofessional Relations, National Affairs, and Salary and Fee Schedules.

One highlight was the report of the new Engineer-in-Industry Committee and the approval of two suggested activities of the committee. As a result, the committee has been authorized to meet with management representatives with a view to exchanging ideas which would be helpful in working out a program for the improvement of the status of the employed engineer. Among the management people who will meet with the committee in this regard are men from consulting firms, electrical manufacturing companies, construction material firms, and the rubber, steel, petroleum, and chemical industries, as well as representatives from other fields.

Following the meeting of the Engineer-in-Industry Committee and the management representatives, the committee has been authorized to publish an informative booklet which will present the items covered by the discussions, although it will not constitute an N.S.P.E. policy statement.

In another important action, the board adopted the so-called "Plan B" for telephone listings. The plan approves listings as in the following example:

Engineers—Registered Professional

CIVIL

John Doe, 400 Dexter Avenue.....Anyplace 9600

ELECTRICAL

John Smith, 100 Main Street.....Anyplace 5500

Vice President C. Y. Thomas, who is also chairman of the Compendium of Registration Laws Committee, gave a status report in which he announced that the first edition now being prepared by former Missouri State Senator A. L. McCawley, will probably be ready about the first of August. The Compendium of Registration Laws will be priced at $7.50 each, but members of N.S.P.E. may purchase them for $5.00 by using a coupon that will be prepared.

It was reported that Engineers' Week has been gaining in stature and in interest to the public. Secretary Robbins told the Board of Directors that about twice as much literature had been requested by various agencies throughout the country to publicize Engineers' Week than had been distributed in the previous year. This material included approximately 150,000 stickers, 1,000 Engineers' Week Kits, 125 Radio Tapes, 34 TV Films and 280 Newspaper Mats. A report of the actual interest and activities of the week will be published at a later date.

The Chairman of the Public Relations Committee, Vice President E. W. Seegar, stated that the third report of the Professional Engineers Conference Board for Industry had been published and was receiving wide distribution. The title of the report is "How to Attract and Hold Engineering Talent." Many publications throughout the country have reviewed the report, including *Aviation Week*, which used eight pages of its magazine to discuss the report, and *Business Week* of December 26th, which gave a page report.

It has been determined that the Professional Engineers Conference Board for Industry, which has been sponsored by the National Society of Professional Engineers, can now receive contributions from agencies or individuals tax free. It is felt that this type of contribution will open considerable avenues for proceeding with the activities of the Conference Board.

It was reported that there are signs throughout the country indicating that the Professional Engineers are more and more standing on their own and that the National Society of Professional Engineers is being recognized as the spokesman for engineers. The Carrier Corporation of Florida used the term "Weather Engineer" in advertisements. After the National Society of Professional Engineers protested the use of the term, the Carrier Corporation immediately removed it from their advertising.

In Marietta, Georgia, the 600 engineers employed at the plant of the Lockheed Aviation Company had a union affiliation with the Engineers and Scientists of America. Recently, by election, the engineers voted to be de-certified and the group is now acting as a non-union group.

These are signs in the wind that augur well for all engineers.

False friends are like our shadow, keeping close to us while we walk in the sunshine, but leaving us the instant we cross into the shade. —*Bovee.*

Our Surface-Water Resources

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(Presented Before Champaign County Chapter, I. S. P. E.)

While the problem of water supply is always important to the engineer in every phase of his work, it is attracting considerable popular interest at the present time because of shortages in many parts of the United States. This is particularly true in southern Illinois. This timely presentation of the general problem by W. S. Daniels discusses a situation which appears to be taking on increasingly serious proportions. *Editor.*

The philosopher Aristotle many years ago considered the world as being composed of the four elements — earth, water, air, and fire. The physical sciences have progressed tremendously since those days, but it is no wonder that for a long time water was regarded as an element. It is in fact the most abundant substance known, occurring in vast quantities in solid, liquid, and gaseous states. Nearly ¾ of the earth's surface is covered by water; about 70% of our body weight and as much as 90% of many plants is water. In the form of vapor, water is always present in the air, even over the driest deserts! The first and most vital problem encountered by the builders of our great cities and by those who located and developed our great industries was where and how to secure an adequate and an unfailing supply of fresh water. Realizing that we depend upon it for our continued existence and progress, we should hold it dear, learning all that we can about it, to use wisely this great natural resource and to ensure an adequate supply for the ever-increasing demands of society.

Although water exists all about us, it is not immediately available for use. If it were, we might have no problem except that of disposal of a huge excess. We should consider, then, the sources of water and the problems which result from its occurrence and from its use.

I hardly need tell you that the greatest portion of the earth's surface is covered by salty ocean water, which is unfit either for drinking or for most of the myriad uses mankind has for fresh, pure water. However, we should be aware that the oceans constitute a vast reservoir, both the end and beginning of a continuous cycle that serves to replenish our supply of fresh water.

In this cycle water evaporates whenever it is exposed to the air, especially from the oceans. It rises into the atmosphere and travels as a part of great air masses over the ocean and land. The vapor is condensed when an air mass rises to pass over another, or over a mountain range, and falls as rain or snow. Much of it falls on the ocean. Some may be condensed directly from the air onto the land as dew. Not all the rain and snow that falls reaches the earth, for some is evaporated while falling, or is evaporated from the surface of a tree or other plant on which it falls.

We begin to measure our available water as it reaches the surface. That which reaches the surface may travel a straight and simple path, or a long-extended and complicated one, but all of it is destined to return to the ocean, the primary reservoir, or again to the atmosphere to be recirculated. There is more than a little truth to the remark, "a drop of water, evaporated from the ocean, rains five times, and returns to the ocean."

Precipitation that falls on the earth may run off immediately, returning via streams and rivers to the ocean, or it may penetrate the top layer of the earth and circulate through the earth as ground water, issuing finally to the surface again and contributing to a stream or river. As ground water it may be absorbed by plant roots, stored temporarily as plant tissue, or evaporated from the pores of the leaves (in the process termed transpiration). The possible paths are numerous and varied, and all phases of the cycle are in motion simultaneously.

I have mentioned only the basic features of the hydrologic cycle. Seemingly countless factors may affect the action of various phases of the cycle; among the factors are air temperature and humidity, wind movement, vegetal cover, topographic and geologic features, and man's appropriations for his needs. Even weather conditions antecedent to precipitation have a pronounced effect subsequently. Surface water runoff, from which man obtains 80% of his total requirements, is a residual—that which is left from precipitation after evaporation, plant life, and the ground have taken all that they can absorb.

How much water is involved in this hydrologic cycle? A tremendous quantity, certainly. For all the area of the United States the amount circulating averages roughly 6.5 million cubic feet per second—somewhere near ten times the average flow of the Mississippi River. Getting down to our own State of Illinois, a study made by the State Water Survey concluded that an average of less than 6% of the total moisture passing over the State during a year fell as measurable precipitation. The average annual precipitation in Illinois varies principally in the north-south direction from 34 inches in the north to 37 inches in the central section and 42 inches in the south, with some areas close to the Ohio River reaching 46 inches.

As would be expected, runoff from Illinois streams varies somewhat similarly, ranging from about 9 inches in the north to about 18 inches in the south. Thus after fulfilling the other requirements of the hydrologic cycle,

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only 30% or so of our precipitation finds its way into the streams draining into the large rivers which nearly enclose the State.

Although the surface streams represent only a minor phase and quantity in the hydrologic cycle, they are nevertheless of utmost importance to man because of the problems involved in their management and use. The problems of management arise from the necessity of draining the land, controlling wasteful erosion, and controlling floods, all of which result from an overabundant supply; and transferring water geographically or in time to spots at which it can be put to the most beneficial use, the transfer being most important when and where the natural supply is deficient to the demand.

The general fields of use of water include municipal supplies, navigation, irrigation, power development, and industrial supplies. Possibly recreational use should be added to this list. Any of these uses would make an excellent topic for lengthy discussion. Inasmuch as municipal supply hits closest to home to each of us, I shall attempt not to go into detail in the other fields. Municipal supply, quantitatively, is only a small portion of the total use of water in the country. If we look at the best estimates available, we find that daily use for municipal supply (ascribed to non-industrial use) is 6.8 billion gallons. Rural use, exclusive of irrigation, is 3.6 billion gallons. Total industrial use, including about 6.8 billion gallons from municipal supplies, is 84.0 billion gallons. Irrigational use amounts to 80.6 billion gallons daily. These add up to 175 billion gallons per day. These quantities are not easy to remember, I know. Perhaps it is simpler to say that of 175 billion gallons used per day, municipal supply takes 4%, rural supply 2%, industrial use 48%, and irrigation 46%. For comparison, water power uses 650% or 1,100 billion gallons daily. This figure includes many reuses of water, as on a stream with numerous power developments, and to that extent differs from the other figures I have given, which for the most part are uses of water that is not immediately available for reuse.

With all the water that is circulating in the hydrologic cycle, why do we have shortages in our supply? For many years the average citizen turned on his faucet and water poured forth; he expected it and developed a thoughtless confidence that it would ever be so. Within the past five years serious shortages have developed affecting our largest cities as well as smaller towns.

The water we use is derived ultimately from precipitation. It follows, therefore, that fluctuations in climate are reflected in changes in available water supply. If the precipitation decreases and the temperature rises, there is less water and more of it is evaporated so that the net supply is doubly reduced. If a reversal in conditions occurs, correspondingly more water is available.

Dry and wet periods alternate during a year. Long-time averages of monthly precipitation show a variation in the annual pattern across the country. San Francisco has wet winters and dry summers; the Great Plains have dry winters and wet summers; New York City has a relatively uniform pattern. In southern Illinois we find a fairly even distribution from November through July, with only a three-month period of relative dryness during August through October when only about 5% per month of the annual precipitation is received. In northern Illinois there is more fluctuation, October through March varying from 6 to 8% of the total per month and April through September varying from 9 to 10½% of the total per month. These are long-term averages. Great deviations are possible and when they occur we have floods or droughts.

Dry and wet years or periods of years follow each other. Accumulating data suggest that precipitation may swing cyclically between periods, each a number of years long, that alternately are appreciably wetter or drier than average. The evidence also points towards a geographic pattern in such long-term variations. Studies in the Missouri River Basin indicate a gradual decline in rainfall over much of the basin during the past 70 years. The tendency may be reversed in a short time, if it has not already done so. As yet, the length and frequency of wet and dry spells cannot be predicted accurately on the basis of cycles. Runoff, like precipitation, fluctuates constantly from day to day, month to month, year to year, and over periods of years.

Our water supply systems, then, must include provision for tiding over periods of deficient rainfall and runoff, with due consideration of the fluctuations within the annual cycle and possible fluctuations over an extended period of years. The system may include a natural or artificial surface reservoir, the great natural underground reservoirs, or under favorable conditions a river with little or no reserve storage capacity, all depending on local conditions. To be satisfactory a public water supply must contain no organisms that cause disease; it should be free from objectionable tastes and odors, and from objectionable gases and minerals; it must be clear and colorless and reasonably soft. Pure water is seldom, if ever, found in nature, because of the solvent power of water and the distribution of finely divided soluble matter in the atmosphere, on the earth's surface, and in the ground. In general, it is possible through various treatment processes to change the quality of natural waters and make them safe and satisfactory for public use.

Some cities are fortunate in having large lakes, streams, or underground sources available to them. Others, particularly tide-water cities, are not so fortunate. The general pattern of securing water supply has been to meet early needs from wells and local reservoirs and to reach out into the country for additional water, successively longer distances as the needs increased. New York forms a typical example, for its first public supply came from wells, later from reservoirs within the present city limits. These became inadequate and a series of large-scale developments began

and is still continuing, barely ahead of demand. In successive stages the city developed its Croton Reservoir system just north of the city, the Catskill Mountain supply from across the Hudson River, and now the upper reaches of the Delaware River in Pennsylvania. Coordinated planning for development of the entire Delaware River Basin is now a necessity in order to avoid possible future conflict among the needs of New York, Philadelphia, and cities in New Jersey.

Boston reached out successively from the city proper to suburbs, to reservoir 25 and 35 miles away, and finally 65 miles away in the Berkshire Hills, to ensure an adequate supply. In 1948, the Boston Metropolitan District Water Supply Commission reported that the Quabbin Reservoir, which was then full, contained enough water to satisfy the existing water demand in the Metropolitan District for 10 years even if no rain fell on the reservoir watershed during that time. Los Angeles, doing things in a big way, has reached 242 miles to bring its water from the Colorado River. Boise, Idaho, a city slightly smaller than Champaign, has a unique claim to fame because of its three water systems for three separate purposes, based on quality and quantity of water available. One is for usual drinking supply, one for irrigation, and one for residential heating from hot springs or wells.

Chicago, we realize, is most fortunate to have Lake Michigan at its doorstep. By far the greater part of the fresh water in storage on the land surface of the United States is contained by the Great Lakes. For the area within the United States this storage is about 12 billion acre-feet—2½ years' average rainfall on all the nation's land area, or 8 years' average runoff to the oceans. Nevertheless, there were shortages of water in some Chicago suburbs this past summer, though certainly not from any shortage in the supply. In these cases the reason was inadequate distribution facilities, which were overtaxed by greatly increased demand. Mains were not large enough or plentiful enough to carry the required volume, and one large pump broke down from overheating, probably due to high temperatures and long-continued use at maximum output.

A basic cause for expansion of water supplies has been the increase in demand resulting from population growth. In the half century ending in 1950 the population of the United States doubled. In the same time the use of municipal water supplies had increased from 100 gallons per capita daily to 150 gallons per capita daily, resulting in a total increase of 300% in water consumption. Estimates of requirements by 1975 indicate an increase in municipal supplies of 45% over 1950.

It is interesting to note that Chicago uses appreciably more gallons of water per person than other large cities in the United States. With 245 gallons per day per capita, Chicago was 25% greater than St. Louis (with 198) and 65% greater than Los Angeles or New York, which had 150. This past summer Chicago broke its own records early in September yhen it pumped 1,470 million gallons in a day, 40% above the August normal.

Many Illinois communities have been short of water this summer and the situation has not yet been relieved. A summary of municipal water-supply deficiencies that had occurred in Illinois this year up to October first has been compiled jointly by engineers of the State Water Survey and the Water Resources Division of the U. S. Geological Survey. The communities that had been affected in the State numbered 65, including a population of almost 600,000. Slightly more than half the people affected were in systems obtaining water from ground-water sources; the remainder were served by surface-water supplies. In 41 cities and communities the shortage was due entirely to the drought and inadequate water source. In 33 cities the trouble resulted from population growth and seasonal rise in water demand. In one case the shortage was attributed largely to industrial use, although inadequate feeder mains to suburban areas was also a factor.

The growth in population, the greatly increased use of water per person, the fact that the best supplies have already been developed, plus realization of the unpredictable variation in our surface water supplies, are all reasons for continuing and expanding the investigations of our water resources.

Precipitation is measured at about 10,000 weather stations in the United States, of which 250 are in Illinois. Coverage is adequate for only parts of the country, the greatest deficiency being in the mountainous areas of the West. An enormous accumulation of data still awaits analysis.

Data on evaporation and transpiration, which absorb some 70% of the precipitation, have been sadly neglected until recent years. A few hundred evaporation pans are maintained by the Weather Bureau, but correlation of results with actual or potential evaporation has not been completely established. Information on quantities of water transpired by various crop plants has been obtained but we still know very little quantatively about transpiration from forest and other native covers.

The United States Geological Survey, in cooperation with the State and local governments and with other Federal agencies, operates more than 6,700 streamflow gaging stations in the United States. These stations are our means, at the earliest opportunity in the hydrologic cycle, for directly measuring the volume of water available for use. They are and will remain a major starting point for water information.

The earliest gaging stations were generally on the larger rivers and at the points at which immediate interest was greatest. As needs expanded and information was required for a growing variety of purposes, the gaging station network was increased and extended to smaller streams and tributaries. In Illinois we now operate 154 stream-gaging stations, and 7 stations on lakes to obtain a record of fluctuations in lake level. In addition 13 gaging stations are operated on the rivers forming parts of the State boundaries.

The situations within the State cover a wide range of drainage areas—the smallest, 1.29 square miles, and the largest 25,300 square miles. There has been developed over the years as an orderly part of the overall program, an investigation of flow from small drainage areas, those of less than 100 square miles. Such a project was recognized as desirable in 1931, but funds were not then available. A program of 40 stations was set up, chiefly on basis of needs for water supply and sewage disposal, and other perennial uses. The first 20 stations finally established were for specific problems, but nevertheless were fairly well distributed over the State. After World War II the State Division of Waterways set up a 20-station project, which has been carried out and expanded. Looking to future investigations and analyses, attempts were made to locate stations in areas having uniform type subsoil and to locate stations so as to have an automatic rain gage within the basin or reasonably close to the gage. Our greatest recent expansion has been in Cook County where drainage problems are important factors in highway design. We now have 61 stations in the small basin network; half of them have 5 years or more of record, and a quarter of them 10 years of record or more. Ten years of record has been considered a minimum necessary for a reasonably reliable appraisal of what can be expected at a station. It will be uneconomical and practically impossible to establish sufficient stations so that one falls at each and every point where it is or becomes necessary to know the streamflow. As time goes on, knowledge required will be of the sort that permits rational transposition of measured flow records to fairly accurate determinations of flow at other points. We look forward to an easing off in establishment of new stations, and development of correlations of intermittent or short-term records with established long-term records at key stations.

The Geological Survey publishes its discharge records annually in a series of 18 volumes of Water-Supply Papers, each volume covering an area whose boundaries coincide with major drainage lines. Here, one may find the basic stream-flow data. Records for Illinois appear principally in Part 5, which includes all Mississippi River tributaries above the Missouri and Ohio Rivers. Some records are in Part 4, the Great Lakes and St. Lawrence River Basin, and the remainder in Part 3A, the Ohio River Basin.

The State Water Survey has been active in the field of municipal water supply, both from ground- and surface-water sources. Among their many published reports are the results of a series of investigations on sedimentation of lakes and reservoirs used for water supply. Soil erosion within a watershed and consequent rapid reservoir sedimentation are serious problems in Illinois; not only have the amounts and rates of deposition been measured, but recommendations for control or alleviation of the problem have been made. Their radar-rainfall studies, which have led to tracking of thunderstorms and measurements of precipitation over certain areas, are familiar to many.

A small cooperative program of water sampling at selected gaging stations for mechanical and chemical analysis is being carried on. Also, as part of a nation-wide effort to obtain data on temperature of surface waters, we are now getting a continuous record of temperature fluctuations at one of the stations at which water samples are taken, the Vermilion River near Catlin. These two programs suggest that we need to know many things about water besides the quantity flowing if we are to have an adequate knowledge of what is available for use.

The Geological Survey, in a long-range program of investigation and analysis for the Division of Waterways, has been working with the stream-flow data now available to digest the information and publish it in forms more useful and of greater benefit to engineers. Many of you, I am sure, are familiar with the two reports already published. The first, in 1948, was "Unit Hydrographs in Illinois." In it unit-hydrographs were developed for 58 gaging stations in Illinois. A unit hydrograph is a hydrograph of direct runoff resulting from one inch of precipitation excess occurring in unit time. It is a useful tool for arriving at discharge from observed or theoretical rainfall data and has its greatest value in developing the flood hydrograph of an area.

The second report, in 1950, was "Water-Supply Characteristics of Illinois Streams," designed to present an over-all picture of the availability of water in the surface streams of Illinois. For each of the gaging stations in

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Illinois, for which suitable record was available, flow-duration curves, curves of discharge available without storage, and storage required to maintain a selected discharge were developed. The value of these for investigating for continuous water supply for any purpose is readily apparent.

To summarize briefly, there is an immense quantity of water continually circulating in the hydrologic cycle. Amounts in various phases of the cycle are ever changing but there is no evidence of increase or decrease in the total. Less than 6% of the moisture in the atmosphere falls in Illinois as precipitation, some 34 to 46 inches annually. Runoff in our streams is roughly 30% of the rainfall. Going one step farther, we use possibly 15% of the water available. Nature provides ample water, but the timing and delivery do not coincide with Man's needs.

Water-supply shortages have developed because rainfall and runoff are variable, and we encounter extended periods of deficiencies. Storage and distribution facilities have in some cases become inadequate, some of them outgrown by the increase in population and increased use per capita. We have much water resources information at hand, but continuing research and investigation is needed to make the data more readily usable and to cope with the anticipated demands of the future.

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Inspector of Bldgs. C.E. or Constr. Age: 35 plus. 10 yrs. exp. in field of bldg. work. Knowledge of construction work. Duties: Act as inspector of building. Can use man who is retired and had previous bldg. constr. exp. Salary: $6000 top. Location: Northern Indiana. C-1716

Graduate Electrical. Duties: general supervisory work in electric and water department of a municipality. Must have exp. in maintenance and construction of electric and water distribution. Salary to $6000. Location: Michigan. C-1718

Sales—Hydraulics. Age: 28-38. 2 plus yrs. exp. in hydraulic work from mechanical phases. Duties: train for sales and application work on mechanical hydraulic equipment to O.E.M.'s. Salary: $450-$550. Employer will negotiate fee. About 40% traveling. Location: Chicago. C-1722

Ind. Engr. I.E. Degree (B.S.). Age: 26 to 35. 2 yrs. exp. time study, operations review, budgets, emphasis on cost control. Know: food processing equip. and operations. Duties: Make time studies of warehousing and production operations to establish costs for planning purposes (No wage incentives); review and analyze plant budgets and operating schedule processes and material flows to improve operating work with plt. supervision to train them in cost control. For a beverage processor. Location: Michigan. Sal.: $4500-$5500. Empl. will neg. fee. Travel. C1690

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General Supt. M.E. or E.E. Age: 35-45. 5 plus yrs. exp. in heavy machining, welding and fabricating of metals. Knowledge of production and modern management. Duties: supervision of 35 foremen in mfg. heavy equipment such as lift trucks, welding, electrical assembly, machining and floor assembly. For a mfgr. of material handling equipment. Salary: $9000-$12,000. Employer will negotiate fee. Location: Chicago. C-1729

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Salesman—College. Age: 25-35. 1 yr. exp. electric wire and cable and magnet wire. Knowledge of wire and cable. Duties: sell wire and cable. Some traveling. Car furnished. Sal.: $6000. Location: Chicago. C-1735

Operating Engineer Assistant. B.S. in E.E. Age: 22-30. 0-5 yrs. exp. electric utility exp. if possible but not essential. Knowledge of electrical engineering. Duties: trained to work in engrg. and operating dept. of water, gas and electric utility at a city of approximately 35,000 population in Northern Wisc. Excellent opportunity for advancement and to gain a wide variety of exp. For water, gas, electric utility. Salary $4000 to $5500 per yr. Location: Northern Wisconsin. C-1736